Heat: An Agent of Change

The Invisible Power of Heat

STUDENT TEXT

Have you ever thought about how heat changes things? Since the beginning of civilization, people have wondered about the invisible power of heat–especially from the Sun.

Over two thousand years ago, a Greek myth demonstrated mankind's relationship with the Sun as a source of heat. Daedalus was a Greek builder who had angered the King. For this, Daedalus and his son Icarus were imprisoned on the island of Crete. They were closely watched by the King's guards. There was only one way for them to escape: by air.

So Daedalus fashioned two sets of wings from feathers, thread, and wax. They resembled the wings of a bird. When the wings were complete, father and son slipped them on and set off from the island, soaring through the air.

They floated higher and higher. Daedalus warned his young son not to fly too close to the sun. But Icarus was so thrilled by the experience that he soared above the clouds, heedless of his father's advice. The heat of the blazing sun softened the wax. It melted and the feathers dropped off. Icarus plunged into the sea and drowned. Today a Greek island is named after Icarus.

You can visit this island and learn more about the myth of Daedalus and Icarus at the following Web site: http://www.island-ikaria.com/myth.htm

This myth tells us that the escape of Daedalus and Icarus could have been successful only if their feathers had stayed attached. Their challenge was to prevent the heat of the Sun from melting the wax. Daedalus succeeded. Icarus did not.

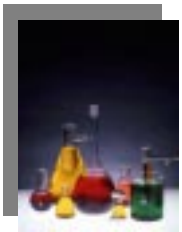
The scientists of the Genesis mission face a similar challenge. They are charged with planning, building, and equipping a spacecraft that can survive a two-year mission in the hostile environment of space. This spacecraft will collect and store particles that are flung from the sun. The side facing toward the sun will be at approximately 200° C. The side facing away from the sun will be much colder, only approximately 20° C. Also, the friction of the

atmosphere during reentry will raise the temperature of the front of the spacecraft to approximately 2000° C. In this mission, heat control is critical to success.

The study of heat has slowly changed from the process of simply observing its effects to understanding and managing it. Early human observations about heat were very basic. Heat changed things. Raw food was different than cooked food.

A lump of clay from a riverbank was different than baked clay. Heating ore rocks produced melted metals. After cooling, these metals could be heated and changed into jewelry or tools or weapons. With heat, sand could even be changed to glass.

Sometimes learning about heat and how it changed things was a matter of trial and error, and accidental discoveries. Sometimes people planned and experimented to learn.

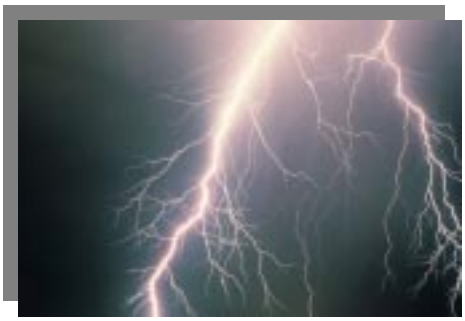


Just over two hundred years ago, scientists put together all that they knew about heat. They developed the **caloric theory**. This theory said that heat was an invisible, tasteless, odorless, weightless fluid called **caloric**. It flowed from one thing into another. The second thing then took up more space and became hotter. Caloric couldn't be created, destroyed, or turned into something else. Adding more and more caloric to a solid object turned it into a liquid and eventually into a gas. Taking caloric away reversed this process.

In other words, they thought heat was a form of invisible matter.

Caloric theory explained what people at that time had observed about heat. However, today we know the caloric theory is not correct. Eighteenth century scientists did not yet fully understand energy as it relates to moving molecules. The idea that all substances were composed of atoms and molecules was not well established.

One man, Count Rumford, watched cannons being drilled in a factory. The bored holes were very hot. He thought about the friction between the drill and the cannon. His observations and insights eventually led to the rejection of the concept that heat was a form of matter. Today we understand that heat is one form of energy.



Most of us in our modern, industrialized, electronic environment take heat for granted. Occasionally, something happens that forces us to notice that organisms exist within a very limited range of temperatures. Power blackouts, downed electric lines, and restricted transportation from storms can leave whole cities or rural areas with no air conditioning or refrigeration in the heat of summer and struggling to keep warm in cold weather. People die, winter and summer, from too much or not enough heat.

Like other Discovery Program missions, the Genesis mission is not manned. This important project leaves the people on the ground and launches specialized, robotic technology into space. The success of the Genesis mission depends on the ability of scientists to anticipate and solve potential problems that heat may cause. They must do this before the spacecraft can fly. With input from the Genesis engineering team, the mythological Icarus might have enjoyed a successful flight.